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S. S. PAPADOPULOS & ASSOCIATES, INC.
ENVIRONMENTAL & WATER-RESOURCE CONSULTANTS

October 31, 2001

Joseph P. Kwan
Director, Environmental Management
TRW Inc.
1900 Richmond Road
Cleveland, OH 44124-3760
United States of America

2001 NOV -2 P 12:56

Subject: **1,4-Dioxane Fate and Transport Assessment**
The Monadnock Company Facility
18301 Arenth Avenue
City of Industry, California

Dear Joe:

As requested by TRW Inc. (TRW), we have analyzed the potential extent of 1,4-dioxane in groundwater downgradient of the Monadnock facility. The purpose of this analysis was to determine if 1,4-dioxane from the Monadnock facility has the potential to impact production wells located downgradient of the site. Our analyses indicate that the closest production wells downgradient of the Monadnock site are the currently unused wells owned by Suburban Water Systems in the mid-valley portion of Puente Valley. Our assessment indicates that 1,4-dioxane from the Monadnock facility will not impact these production wells, as the downgradient extent of 1,4-dioxane concentrations in excess of 3 ug/L, the California Department of Health Services (DOHS) action level, is less than 2000 feet from the Monadnock facility. The calculated extent of the 1,4-dioxane plume and the location of the Suburban Water Systems wells are shown on the attached Figure 1.

Issue

1,4-dioxane, a compound commonly used as a stabilizer in 1,1,1-TCA, has been detected in groundwater monitoring wells at the Monadnock facility since 1999. In the last monitoring round in July 2001, 1,4-dioxane was detected in three of the monitoring wells at the site, MW-2, MW-7, and MW-12, at concentrations of 13 ug/L, 5.5 ug/L, and 37 ug/L, respectively. The maximum concentration reported during the past two years was 52 ug/L at monitoring well MW-2. The actual downgradient extent of 1,4-dioxane concentrations above the regulatory limit has not been determined on the basis of monitoring data because there are no monitoring wells for over 2,000 feet downgradient of the Monadnock facility. Therefore, we used a groundwater model to estimate the downgradient extent of 1,4-dioxane.

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Suburban Water Systems owns four wells in the mid-valley area that formerly were used for groundwater production. These wells are referred to as wells 123W1, 131W1, 155W1, and 155W2. These out-of-service wells, located more than 14,000 feet downgradient of the Monadnock facility, are the closest production wells to the subject site.

Method of Analysis

We developed groundwater flow and contaminant transport models of the Puente Valley for TRW in 1999 to assist in the allocation of remedial costs among members of the Puente Valley Steering Committee. The models we developed were based on the groundwater models developed by Camp, Dresser & McKee (CDM). The computer codes MODFLOW and MT3D-99 were used for simulating groundwater flow and transport.

The model domain includes the Puente Valley and that portion of the San Gabriel basin where pumpage may influence groundwater conditions within the Puente Valley. The grid incorporates 136 columns oriented in a north-south direction, 85 rows, and 9 layers (refer to Figure 2). The model cells are 330 by 330 feet in the central part of the model domain.

The vertical discretization of the grid into 9 layers provides representation of the principal aquifer and aquitard units in the basin. The attached Figure 3 is a cross section through the model domain showing the model layers. The eastern-most well shown on this figure is monitoring well MW-11 at the Monadnock facility. This well is approximately 100 feet deep, and in the model this well penetrates the upper six model layers.

Model parameters and model boundary conditions were initially taken from those specified in the CDM groundwater flow model. The regional model parameters were adjusted using an automated calibration procedure, and subsequently through a trial-and-error approach. The model was calibrated to 1995 water-level data, and then the calibration was checked with a transient simulation of the period 1955 to 1995. The calculated water levels in model layer 4, the model layer in which many of the monitoring wells at the Monadnock facility are completed, is shown on the attached Figure 4. The model simulated and measured water levels correspond well.

The upper four model layers in the vicinity of the Monadnock facility are each about 10 feet thick. The hydraulic conductivities in these layers were specified as 11.5 ft/day, 92.5 ft/day, 10 ft/day, and 3 ft/day, respectively. These hydraulic conductivities are consistent with lithology at the facility.

Once the groundwater flow model was calibrated, a transport model was developed using the program MT3D-99. The transport parameters used in the model were: longitudinal dispersivity of 33 feet, transverse dispersivity of 3.3 feet, and an effective porosity of 0.2. These estimates are

based on available site data in the Puente Valley and were adjusted during model calibration to provide the closest agreement between observed and calculated plume lengths.

These models were used to estimate the potential downgradient extent of 1,4-dioxane in groundwater from the Monadnock facility. This compound was assumed to have a retardation factor of one (i.e., no retardation). For this analysis, groundwater beneath a source area at the Monadnock facility was specified as having a constant 1,4-dioxane concentration of 37 ug/L. This source was assumed to have existed since 1968, which is the date when widespread usage of 1,1,1-TCA as an industrial solvent became common. The results of our analysis indicate that the 1,4-dioxane plume reached steady state conditions downgradient of the facility in the late 1980's, and that concentrations in excess of 3 ug/L extend less than 2,000 feet downgradient of the facility. This analysis indicates that the 1,4-dioxane concentrations in groundwater are significantly attenuated downgradient of the facility as the result of dispersion and dilution in the aquifer. We calculated that the effective attenuation factor between the Monadnock facility and the mid-valley production wells is greater than 1000 (concentrations are reduced by a factor of greater than 1000 between the facility and the Suburban Water Systems wells).

Conclusion

The results of the contaminant transport modeling conducted for 1,4-dioxane in groundwater at the Monadnock facility indicate that the plume reached steady state conditions over ten years ago and that it extends less than 2,000 feet downgradient of the facility. The relatively low concentrations of 1,4-dioxane reported in groundwater in the vicinity of the Monadnock facility, combined with the natural attenuation processes occurring in the groundwater system downgradient of the facility, make it improbable that detectable 1,4-dioxane concentrations will occur in the closest downgradient production wells, located in the mid-valley portion of Puente Valley.

If you need additional information, please call.

Sincerely,

S. S. PAPADOPULOS & ASSOCIATES, INC.

Charles Andrews

Charles B. Andrews, PhD
President

Attachments

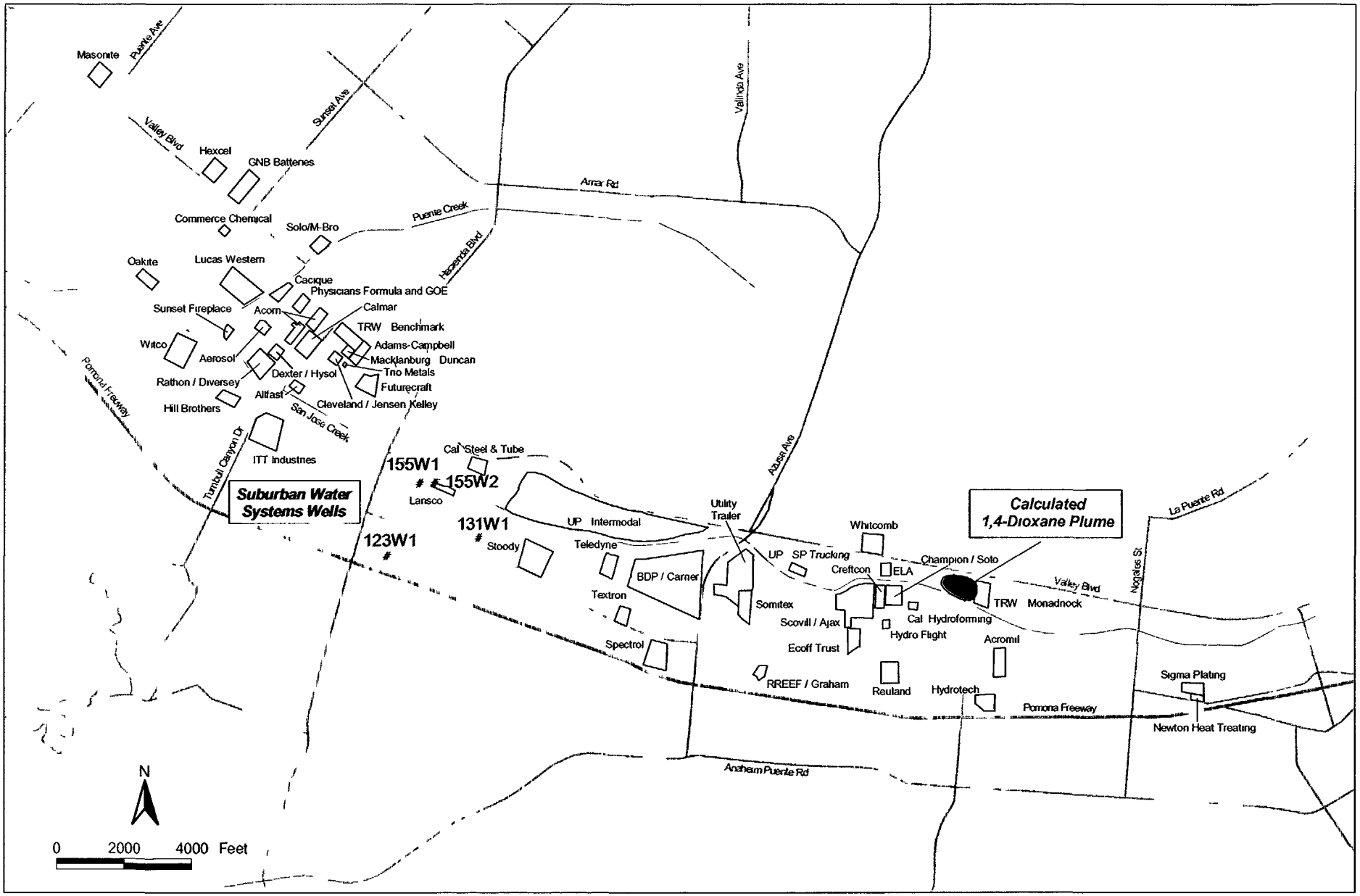


Figure 1 Puente Valley

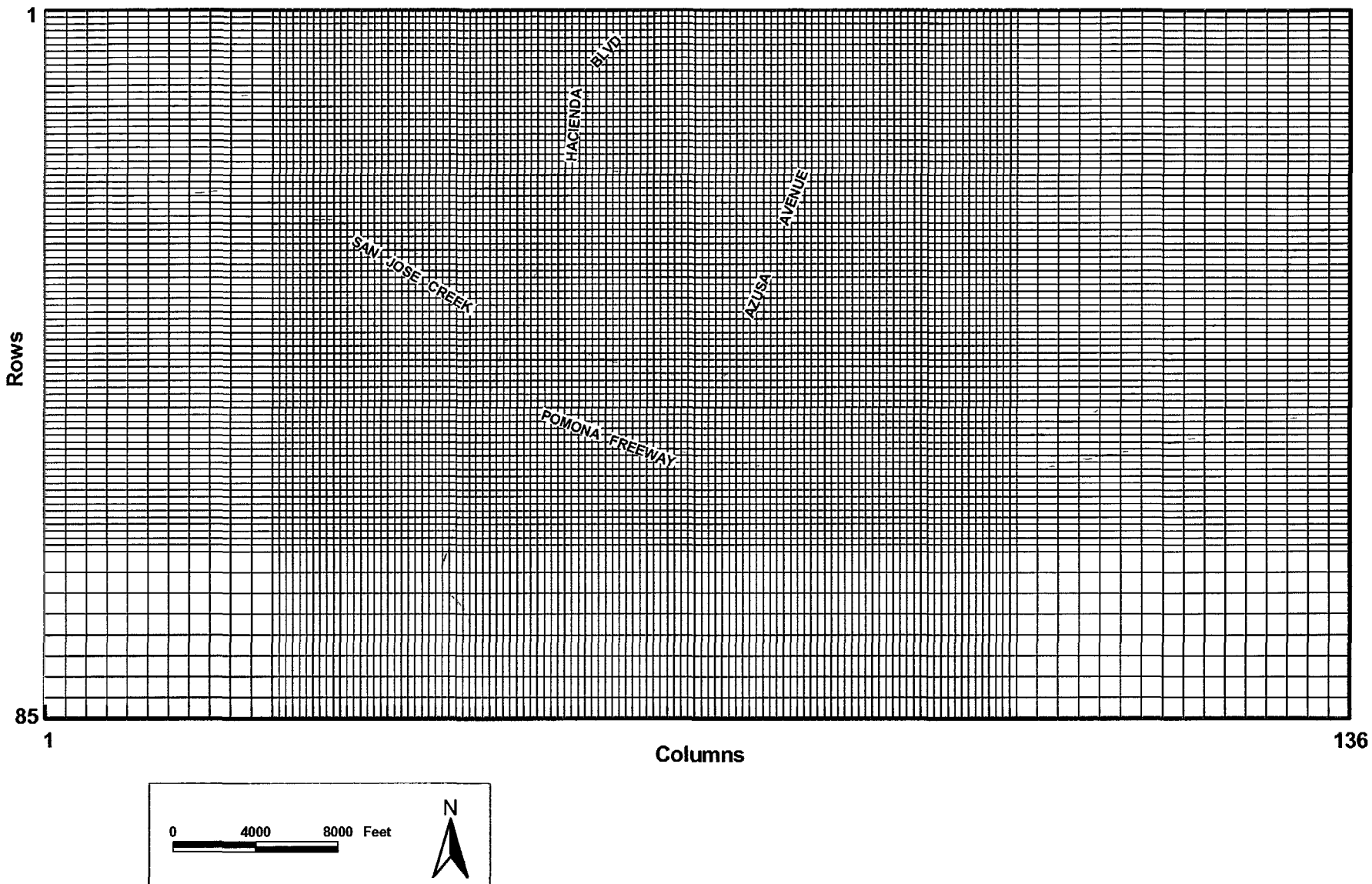
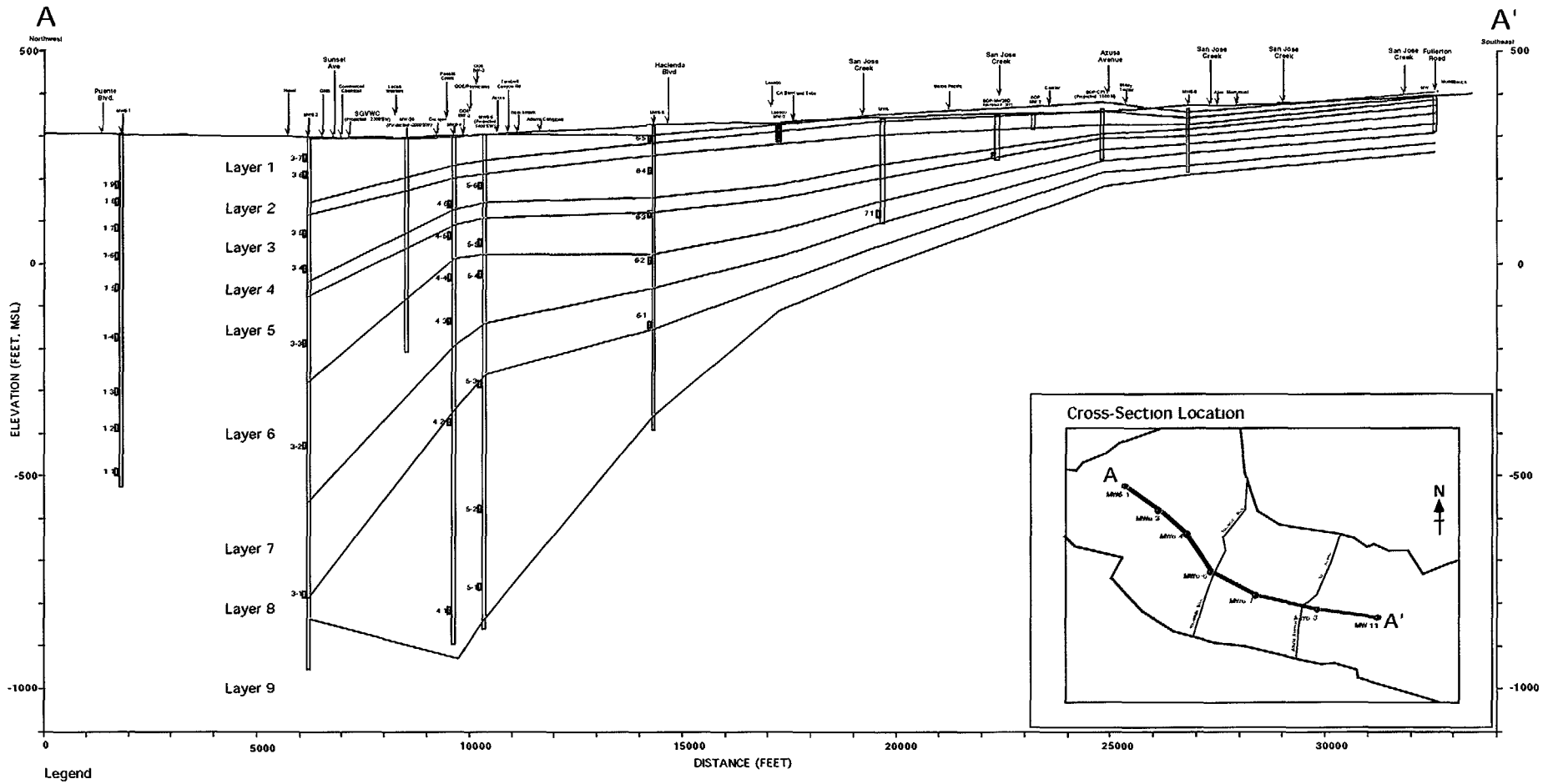


Figure 2 Model Area and Grid



Legend

6 1 Well Screen and Designation

Modified after Statement of Position for GOE Engineering Inc
Prepared by Robert L Stoller et al, October 18, 1999

0 200 400 feet
Vertical Scale

0 2000 4000 feet
Horizontal Scale

Figure 3

Cross-Section of Model Layers

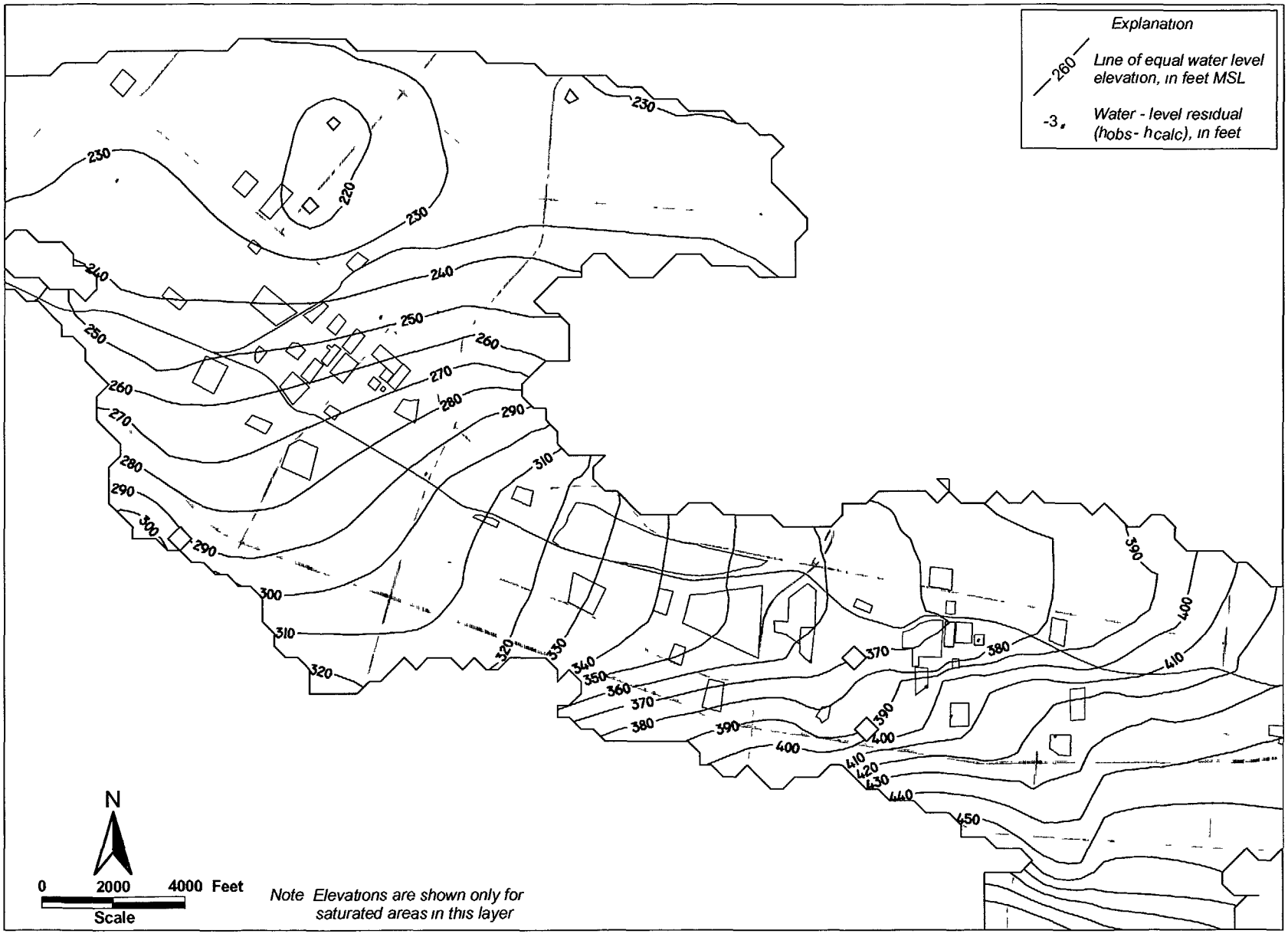


Figure 4 Calculated Water Levels in Model Layer 4